Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

SHOUT
SHARE
IT

FIG. 1.—CONNECTICUT CUBAN TOBACCO, FIRST YEAR FROM CUBA.

FIG. 2.—THE SAME FIELD SHOWN IN FIGURE 1, AFTER SAVING SEED UNDER BAG AND THE SELECTION OF THE BEST PLANTS FOR TWO YEARS.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF PLANT INDUSTRY—BULLETIN NO. 91.

B. T. GALLOWAY, *Chief of Bureau.*

VARIETIES OF TOBACCO SEED DISTRIBUTED IN 1905-6, WITH CULTURAL DIRECTIONS.

BY

A. D. SHAMEL AND W. W. COBEY,

IN CHARGE OF TOBACCO BREEDING EXPERIMENTS, LABORATORY OF PLANT BREEDING.

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

ISSUED FEBRUARY 21, 1906.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1906.

BUREAU OF PLANT INDUSTRY.

B. T. GALLOWAY,
Pathologist and Physiologist, and Chief of Bureau.

VEGETABLE PATHOLOGICAL AND PHYSIOLOGICAL INVESTIGATIONS.
ALBERT F. WOODS, *Pathologist and Physiologist in Charge, Acting Chief of Bureau in Absence of Chief.*

BOTANICAL INVESTIGATIONS.
FREDERICK V. COVILLE, *Botanist in Charge.*

FARM MANAGEMENT.
W. J. SPILLMAN, *Agriculturist in Charge.*

POMOLOGICAL INVESTIGATIONS.
G. B. BRACKETT, *Pomologist in Charge.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.
A. J. PIETERS, *Botanist in Charge.*

ARLINGTON EXPERIMENTAL FARM.
L. C. CORBETT, *Horticulturist in Charge.*

INVESTIGATIONS IN THE AGRICULTURAL ECONOMY OF TROPICAL AND SUBTROPICAL PLANTS.
O. F. COOK, *Bionomist in Charge.*

DRUG AND POISONOUS PLANT INVESTIGATIONS, AND TEA CULTURE INVESTIGATIONS.
RODNEY H. TRUE, *Physiologist in Charge.*

DRY LAND AGRICULTURE AND WESTERN AGRICULTURAL EXTENSION.
CARL S. SCOFIELD, *Agriculturist in Charge.*

EXPERIMENTAL GARDENS AND GROUNDS.
E. M. BYRNES, *Superintendent.*

SEED LABORATORY.
EDGAR BROWN, *Botanist in Charge.*

J. E. ROCKWELL, *Editor.*
JAMES E. JONES, *Chief Clerk.*

SEED AND PLANT INTRODUCTION AND DISTRIBUTION.

SCIENTIFIC STAFF.

A. J. PIETERS, *Botanist in Charge.*

DAVID FAIRCHILD, *Agricultural Explorer, in Charge of Foreign Explorations.*
W. W. TRACY, SR., *Superintendent of Testing Gardens.*
JOHN E. W. TRACY, *Assistant Superintendent of Testing Gardens, in Charge of Congressional Seed Distribution.*
O. W. BARRETT, *Assistant.*
GEORGE W. OLIVER, *Expert.*
C. V. PIPER, *Agrostologist, in Charge of Forage-Crop Investigations.*
J. M. WESTGATE, *Assistant Agrostologist, in Charge of Alfalfa and Clover Introduction.*
W. W. TRACY, JR., *Assistant Botanist.*
FRANK N. MEYER, *Agricultural Explorer.*
CHARLES F. WHEELER, *Expert.*
A. B. CONNOR, *Special Agent.*
JOHN H. TULL, *Special Agent, in Charge of Matting-Rush Investigations.*
HAROLD T. NIELSEN, *Scientific Assistant in Agronomy.*

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of the Chief,
Washington, D. C., December 11, 1905.

Sir: I have the honor to transmit herewith a paper entitled "Varieties of Tobacco Seed Distributed in 1905–6, with Cultural Directions," and respectfully recommend that it be published as Bulletin No. 91 of the series of this Bureau.

This paper was prepared by Messrs. A. D. Shamel and W. W. Cobey, in charge of tobacco breeding experiments, Laboratory of Plant Breeding, and it has been submitted by the Botanist in Charge of Seed and Plant Introduction and Distribution with a view to publication.

The illustrations which accompany this paper are considered essential to a full understanding of the text.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary of Agriculture.

PREFACE.

Following the established policy of this office of improving the methods of distributing seed wherever possible, a departure has this year been made in the handling of the tobacco-seed distribution, the work of selecting the types which it is desired to distribute being undertaken by the tobacco experts of the Laboratory of Plant Breeding of the Bureau of Plant Industry. This, it is believed, will result in placing in the hands of really interested persons the very best seed of the various types of tobacco. Some of these types will be entirely new, the results of selection and breeding by Messrs. Shamel and Cobey during the past two or three years. Other types will be such as are already established, but the seed distributed this year has all been carefully selected with reference to securing the best possible strain of each type.

Special attention has been paid in the present bulletin to a discussion of the methods of growing and handling certain varieties, especially those that are more highly specialized. This course was considered necessary, because even if good tobacco is grown it is easily spoiled by improper handling. It is hoped that those who read these pages will pay special attention also to the discussion of the selection of seed, because the permanent improvement of tobacco types must necessarily be left in the hands of intelligent cultivators, and if careful selection is not practiced by them the work which the Department of Agriculture is doing will fail to attain the full measure of success which would otherwise be possible.

A. J. Pieters,
Botanist in Charge.

Office of Seed and Plant
Introduction and Distribution,
Washington, D. C., December 11, 1905.

CONTENTS.

	Page.
Introduction	9
Description of varieties	11
Cigar-wrapper tobaccos:	
Sumatra	12
Connecticut Havana	12
Connecticut Broadleaf	12
Cigar-filler tobaccos:	
Cuban	13
Zimmer Spanish	13
Little Dutch	14
Pipe tobaccos:	
North Carolina Bright Yellow	14
Maryland Smoking	14
Plug tobaccos:	
White Burley	14
Orinoco and Yellow Mammoth	15
Virginia types (Blue Pryor, Sun-Cured, and White Stem)	15
Directions for culture:	
Sumatra tobacco	15
Connecticut Havana tobacco	20
Connecticut Broadleaf tobacco	27
Cuban tobacco	29
Zimmer Spanish and Little Dutch tobaccos	30
Maryland Smoking tobacco	31
North Carolina, Tennessee, and Virginia tobaccos	32
White Burley tobacco	33
Insect enemies	34
Directions for saving seed	34
How to secure good seed	37
Description of plates	40

ILLUSTRATIONS.

Page.

PLATE I. Fig. 1.—Connecticut Cuban tobacco, first year from Cuba. Fig. 2.—The same field shown in figure 1, after saving seed under bag and the selection of the best plants for two years ..... Frontispiece.

II. Fig. 1.—Tobacco seed bed in Florida. Fig. 2.—Tobacco seed beds in Connecticut—tent, hotbed, and cold frame 40

III. Fig. 1.—Transplanting tobacco seedlings with machine. Fig. 2.—Sterilizing soil for tobacco seed beds 40

IV. Fig. 1.—Tobacco seed separator. Fig. 2.—Seedlings from heavy, medium, and light tobacco seed 40

V. Fig. 1.—Method of "spearing" tobacco plants during harvest. Fig. 2.—Wagon rack for transporting plants to curing shed 40

VI. Fig. 1.—Capped plants saved for seed. Fig. 2.—Curing shed in the Connecticut Valley 40

VII. Fig. 1.—Seed plant ready for bag. Fig. 2.—Proper arrangement of bag on seed plant 40

VIII. Fig. 1.—Arrangement and structure of tobacco flowers. Fig. 2.—Two strains of Connecticut Broadleaf tobacco, the row on the left from an early parent and the row on the right from a late parent. 40

IX. Fig. 1.—Uniformity in time of maturity and other characters of two types of Connecticut Sumatra tobacco raised from seed saved under bag. Fig. 2.—Lack of uniformity in time of maturity and other characters in ordinary Connecticut Broadleaf tobacco 40

B. P. I.—193. S. P. I. D.—52.

VARIETIES OF TOBACCO SEED DISTRIBUTED IN 1905–6, WITH CULTURAL DIRECTIONS.

INTRODUCTION.

In the distribution of tobacco seed by the Department of Agriculture small samples of seed of improved native and standard foreign-grown varieties are furnished for experimental purposes. The object of this distribution in regions where tobacco is not grown at present is to enable farmers to make a reliable test of the adaptability of their conditions of soil and climate to tobacco culture. In the established tobacco-growing sections the growers may secure improved varieties by testing the seed, sent out in this distribution, adapted to the conditions of culture and purposes of manufacture for which the tobacco is grown. The Havana seed tobacco of the Connecticut Valley and the Florida Sumatra type of the southern Georgia and western Florida districts are striking illustrations of the beneficial results of the introduction of new varieties or the importation of standard foreign-grown tobaccos.

Many illustrations might be cited of the importance of testing different varieties of tobacco in the established tobacco-growing sections, and it is the object of this distribution to furnish tobacco growers carefully selected seed of improved strains of standard varieties of tobacco, in order that they may obtain the best types of tobacco adapted to their conditions of soil and climate.

In all cases where foreign-grown or improved native varieties have been successfully established in any region, small crops have been grown until the strains have become adapted to local conditions of climate and soil and a uniform type has been secured by continued and systematic selection of seed.

In the distribution of tobacco seed this season, unless a particular variety of tobacco is requested by the growers an attempt will be made to send the variety of tobacco which experience has shown to be most nearly adapted to the conditions under which the tobacco is to be grown. It has been found by experience that an attempt to produce a tobacco on a soil not suited to the type planted will in most cases

result in failure, from the fact that the tobacco produced is unfit for the same grade as the parent plants and will not meet the requirements of an established class of tobacco, but must sell as a nondescript. In some cases, however, new types of tobacco have been established in this way which have proved of sufficient importance to create a market on their own merit, and wherever it seems possible that such results may be secured the seed of highly bred new varieties will be sent to the particular section adapted to the growth of these types.

The tobacco plant readily adapts itself to a great variety of conditions, but is easily affected by the chemical and mechanical conditions of the soil. In fact, it has been found that the relation of the physical conditions of the soil to the texture and quality of the leaf has become so well established that it is possible to determine in a general way by a study of the soil and climate the adaptability of the different sections to a particular type and class of tobacco. The climatic conditions largely influence the quality and aroma in the same way that the soil influences the texture of the tobacco leaf. In a warm climate the tendency is to produce a leaf with a large amount of gum and an aromatic tobacco; in northern sections the leaf becomes larger and finer, but is lacking in aroma. However, these tendencies may be modified in different sections by excessive rainfall, which usually causes a thin leaf and lack of aroma.

As a rule, tobacco which is grown near the sea has poor combustibility, which is supposed to be due to the action of the chlorin in the salt of the sea air. As a general rule, tropical climates produce the best tobaccos for cigar fillers, and temperate climates produce tobaccos which are best adapted for cigar wrappers. In the warmer sections of temperate climates the best smoking and chewing tobaccos are produced.

It has been definitely determined by experiments conducted by the Bureau of Plant Industry that the different types of tobacco can be greatly improved by seed selection and breeding. Inasmuch as the tobacco plant produces a large quantity of seed, it is possible by saving comparatively few plants to furnish enough highly bred seed for the planting of a large area. It is important that where new strains or varieties of tobacco are tested by the growers a small number of plants be grown the first year, in order to test the adaptability of these tobaccos to the local conditions. If the variety proves to be of value the grower can select the best of the individual plants in this small field for the seed of his entire crop the succeeding year.

The importance of growing a small crop from imported or newly introduced seed is illustrated in Plate I. In figure 1 is shown a field in the Connecticut Valley in the season of 1903, grown from freshly imported Cuban seed. It can be seen that in this field there are a large number of "freak," branching, narrow-leaved, and other unde-

sirable types of tobacco for cigar-wrapper purposes. The number of freak plants in this field amounted to one-third the total number of plants and caused the grower a great loss. Specially good plants, free from suckering, were selected for seed in this field, and the seed saved under bag. The crop the following season raised from this seed was comparatively free from freaks and undesirable plants. In 1905 the crop shown in figure 2 from seed saved from the preceding year's selected seed plants of this same variety on the same field was remarkably uniform in type, every plant being like every other plant in the field. A casual inspection of the two figures will show that two years' systematic seed selection, saving the seed under bag, has served to weed out all of the freak and undesirable types and has enabled the grower to produce a uniform field of a highly desirable type of tobacco.

There is no general farm crop which responds so readily to seed selection and breeding as tobacco. The transmitting power of the individual parent plants is exceedingly strong, and the progeny of the individual seed plants show great uniformity when seed is saved under bag according to the plan outlined in the following pages.

It is exceedingly important that strains of tobacco be secured in different sections resistant to the "root knot," "root wilt," and other fungous diseases which attack the tobacco crop. In the experiments conducted by the Bureau of Plant Industry it has been found that by saving the seed of resistant plants under bag it is possible to produce uniform strains which are immune to the attack of most root diseases. Wherever possible the Department will undertake to make selections of resistant types and furnish small quantities of this seed for distribution.

It is advisable for tobacco growers to secure and test new varieties in different sections, and especially to secure hybrids of the native with the imported varieties. In order to safely introduce these hybrids it is essential to grow a few plants of the desired imported variety in order to procure pollen for crossing. In no instance should a large area of plants be grown from the first year's cross or from the imported seed. One hundred plants of each type or variety will give a fair indication of the nature and value of the cross or importation, and will furnish sufficient plants for seed selection for the next year's crop. After the grower secures a uniform crop of the desired kind sufficient seed may be saved for future crops in accordance with the directions given in this bulletin.

DESCRIPTION OF VARIETIES.

It is impossible to recommend the best variety of tobacco for growing in a new region, that being a matter which can only be determined by careful experiments. If the soil and climatic conditions are known, a study of the description of the varieties sent out in this distribution will enable the grower to select a variety which will be adapted most

nearly to the new conditions. In the following list the best varieties for testing by the growers are grouped with reference to their uses and the character of soil which produces the best yield of each variety, as determined by past experience.

CIGAR-WRAPPER TOBACCOS.

Sumatra.—Used wholly for the production of high-grade cigar wrappers and not considered of any value for fillers. In the United States this variety is grown under slat or cloth shade. Adapted to sandy loam soil. In western Florida, where it is grown extensively, the surface soil is underlaid by a red clay subsoil. The leaves are very thin, of fine texture, with small veins, and vary from 12 to 20 inches in length and 8 to 16 inches in width. The plants bear from 16 to 30 leaves, with comparatively long internodes. The leaves have an erect habit of growth. Under favorable conditions for growth the plants reach a height of from 7 to 9 feet. This variety produces the best grade of domestic cigar wrappers.

Grown in western Florida, in southern Georgia, and in the Connecticut Valley.

Connecticut Havana.—Used for cigar wrappers and binders, and the top leaves are frequently used for fillers in the inferior grades of domestic cigars. Adapted to light alluvial, sandy soils, containing a small percentage of clay, and as a rule the less the clay the higher the yield of fine cigar wrappers. Where this variety is grown for fillers a rich clay yielding a heavy crop of leaf is probably the most desirable type of soil. The leaves are thin, of fine texture and delicate flavor, set very close together on the stalk, with very short internodes, and have a very erect habit of growth. The plants bear from 10 to 15 leaves, varying in average length from 20 to 32 inches and in average width of from 10 to 15 inches. This variety was secured by continued seed selection from crops grown from seed imported from Cuba, and is probably a cross between these Cuban plants and the native Broadleaf of the Connecticut Valley.

Grown in the Connecticut Valley, Wisconsin (mainly for binders), Ohio, Pennsylvania, and New York. One of the best general-purpose tobaccos.

Connecticut Broadleaf.—Formerly known and generally recognized in the trade as Seedleaf. Used for cigar wrappers and binders, and the lower grades, to a limited extent, for blending with other tobaccos for cigar fillers. Adapted to sandy loam soil. This variety makes an exceedingly rapid growth. The leaves are very broad, sweet tasting, thin, elastic, silky, and with small veins. The leaves are set very close together on the plant, having a very characteristic drooping habit of growth, and vary in length from 24 to 36 inches and in width from 12 to 22 inches. The size of leaf varies greatly in different sections

and with the different strains which have been developed by individual growers. The seed of this variety has been sent to many sections of the United States and a large number of important varieties have been secured from this source, as in the case of the Ohio Seedleaf, which can be traced directly to Connecticut Broadleaf seed.

Grown in the Connecticut Valley, New Hampshire, Vermont, New York, Pennsylvania, Ohio, Wisconsin Minnesota, and to a slight extent in Indiana and Illinois.

CIGAR-FILLER TOBACCOS.

Cuban.—Used for high-grade cigar wrappers when grown under shade, but is generally grown outside for cigar fillers. Adapted to alluvial or sandy soil resting on red clay subsoil. This variety has a small leaf of fine texture. The leaves are short and round, with small veins, medium to heavy body, varying from 10 to 18 inches in length, and 6 to 14 inches in width. When this variety is taken north the influence of the climate and soil conditions tends to promote the development of a large leaf at the expense of fineness of texture and quality. When grown from freshly imported seed in southern tobacco districts the tobacco seems to retain the valuable qualities of flavor, aroma, smooth taste, and other characters of the imported Cuban tobacco. Whether these qualities can be retained by continued selection of seed from desirable plants is a subject for experimentation, but the evidence obtained up to this time indicates that it is probable that in certain districts in the United States uniform crops of Cuban tobacco having a highly desirable flavor and aroma can be produced by the aid of systematic seed selection.

In the Connecticut Valley this variety is grown under shade for cigar wrappers, the top leaves being used to a limited extent for cigar fillers, and it is grown for cigar fillers in Florida, Texas, Ohio, and Georgia. In Florida and Texas it produces one of the best grades of domestic fillers.

Zimmer Spanish.—Largely used for cigar fillers, and is the most popular and extensively grown domestic filler. It is frequently used for blending with other tobaccos in cigar fillers. It is commonly believed to be a hybrid of the native Seedleaf and the Cuban variety. Adapted to light loam soil, and in the Miami Valley, Ohio, where this variety is most extensively grown, the surface soil is underlaid by a red-brown clay loam. The leaves are medium in size, have good body and elasticity, with small veins, and they resemble the Cuban variety. The leaves are set close together on the stalk, from 14 to 20 leaves to the plant, the plants reaching an average height of about 4 feet. This variety produces an average yield of about 600 pounds to the acre and brings an average price of about 7 cents a pound.

Grown in Ohio and Wisconsin.

Little Dutch.—Used for cigar fillers, making a cigar with an aroma resembling the Yara tobacco grown in eastern Cuba. Adapted to clay loam soils. The seed was introduced in this country from Germany. The leaves are small and narrow and the plants have a short habit of growth, producing a light yield. This tobacco requires careful curing and fermentation.

Grown in Ohio and to a limited extent in Pennsylvania.

PIPE TOBACCOS.

North Carolina Bright Yellow.—Used for manufacturing plug and smoking tobaccos, cigarettes, and for export purposes. This variety is adapted to sandy soils, underlaid by a red or yellow clay subsoil. The deeper the sand the brighter the tobacco produced, and the nearer the surface the subsoil comes the more inclined the tobacco is to darken in color. The leaves are light and spongy, of rather thick texture, set close together on the stem, with an erect habit of growth, but drooping at the ends, the tops often touching the ground. This variety is a modified type of the native Maryland and Virginia tobaccos.

Grown in North Carolina, Maryland, Virginia, and South Carolina.

Maryland Smoking.—Used for manufacturing and export purposes. Adapted to clay loam and sandy soil. The leaves are thick and coarse in texture, but are light and chaffy when cured. They have a semi-erect habit of growth, drooping at the tips, varying in length from 20 to 36 inches and in width from 10 to 26 inches. The plants bear from 10 to 18 leaves and reach an average height of about 4 feet. This variety was discovered in Maryland when the first settlers explored that region. It is mostly exported to France, Germany, and Holland.

Grown in Maryland, Virginia, and Pennsylvania. From the Maryland tobacco many of the important native varieties have been developed by growing in different tobacco-growing sections and by continued selection of seed for a particular type of tobacco.

PLUG TOBACCOS.

White Burley.—Used for plug fillers and wrappers for smoking and for the manufacture of cigarettes. Adapted to well-drained, deep-red clay-loam soil. In Kentucky such soils are fairly rich in lime and produce good crops of corn, wheat, hemp, and grass, but they deteriorate rapidly unless the fertility is maintained by the use of fertilizers and proper methods of cultivation. The leaves are long and broad and have a white appearance in the field. They have a horizontal habit of growth, the tips hanging down and often touching the ground. They vary in length from 28 to 36 inches and in width from 16 to 24 inches. The plants bear from 10 to 18 leaves and reach an

average height of about 4 feet in the field. This variety is a selection from the original Burley, the peculiar white, translucent appearance of the original parent plant having attracted the attention of the growers. Seed saved from this plant produced a large number of plants the following season, and in time a large and important industry was developed from this beginning.

The Red Burley and dark tobaccos of southern and western Kentucky and Tennessee are heavy tobaccos, nearly related to the White Burley, but on account of their peculiar characteristics are largely exported.

Grown in Kentucky, southern Ohio, Tennessee, and to a limited extent in North Carolina and Virginia.

Orinoco and Yellow Mammoth.—Used for plug wrappers and fillers and are stemmed for export trade. Adapted to rich, well-drained soils, doing especially well on alluvial soils underlaid with red clay subsoil. The Orinoco variety has short, broad leaves, while the Yellow Mammoth has large leaves, both varieties having a rapid rate of growth. The Little Orinoco type has a long, narrow, tapering leaf, and is the sweetest variety grown. The Yellow Mammoth is largely exported for Swiss trade, and its culture is mainly confined to Tennessee.

The Orinoco type is grown in Virginia, North Carolina, Tennessee, West Virginia, and Missouri.

Virginia types (Blue Pryor, Sun-Cured, and White Stem).—Adapted to sandy soil, underlaid with red or yellow clay subsoils. These types have very broad, large, fine leaves, of fine, silky texture, with rather tough fibers and usually have bright, fine colors. Some of the best grades are used for cigar wrappers and others for smoking purposes.

Grown in Virginia, North Carolina, Kentucky, Tennessee, Missouri, and Indiana.

DIRECTIONS FOR CULTURE.

SUMATRA TOBACCO.

The location selected for the seed bed should have a slightly southern exposure in order to get the full benefit of the warm rays of the sun in the early spring. The slope should be sufficient to insure perfect drainage at all times. It is desirable that the seed bed be surrounded by board walls and covered with regular tobacco tenting cloth, an illustration of which is shown in Plate II, figure 1. The cover will protect the tender plants from the cold north winds and produce more uniform and favorable conditions, insuring early, rapid growth. The location should be permanent, abundantly fertilized every spring, and kept free from weeds and grass at all times. The soil becomes better adapted to plant-bed purposes each succeeding year if this method is

followed. The most desirable soil seems to be a rich, friable sandy loam. Deep plowing or spading should be avoided in the preparation of the soil, the usual depth being 4 or 5 inches. The ground should be harrowed and stirred with hand rakes until thoroughly pulverized, and all roots, tufts, and clods of earth should be carefully removed.

After this preparation a liberal application of fertilizer rich in nitrogen and potash should be evenly distributed over the bed. A fertilizer containing 10 per cent of ammonia, 8 per cent of available phosphoric acid, and 12 per cent of soluble potash is highly recommended. Chlorin in any form must be avoided. After applying this fertilizer the bed should be thoroughly stirred again and left very smooth, in which condition it is ready for the seed. It is customary to sow the seed at the rate of about 1 tablespoonful to 100 square yards of seed bed. It is impracticable to sow this seed alone and it should be thoroughly mixed with wood ashes, corn meal, land plaster, or commercial fertilizer. In order to obtain a uniform stand of plants it is advisable to sow half of the seed lengthwise of the bed and the remainder crosswise.

The proper time for sowing the seed is from February 1 to March 1. Wherever practicable it is best to prepare the land and apply the fertilizer from one to two weeks before sowing the seed. After sowing, a light roller should be run over the bed, or some other means used to get the soil in a firm, compact condition, in which state it will retain its moisture, thus giving more favorable conditions for the germination of seed and the growth of the young plants. The necessity of properly caring for the seed bed can not be too strongly emphasized, since nothing is of more importance in obtaining a vigorous growth in the field than strong, healthy seedlings. They should be made to grow steadily and vigorously without being checked until ready for transplanting. In order to obtain this condition, strict and constant attention must be given to watering the bed, keeping down all weeds and grass, and preventing the ravages of insect pests. In some cases it is necessary to use an additional application of fertilizer in the way of a top-dressing. The necessity for this is often indicated by the plants turning yellow. The fertilizer should be essentially of the same composition as that previously used, and often gives best results when applied in a liquid form. This method of application makes it necessary to wash the fertilizer thoroughly into the soil by means of an abundant spray and thus avoid injury to the tender plants.

Whenever it is found that the plants are too thick in the bed it is advisable to thin them out by drawing an ordinary rake across the bed, allowing it to sink to a depth of from one-half to three-fourths inch. This can be done without seriously injuring the remaining plants and is, in fact, of positive benefit to them. In all cases some system should be provided for watering the plant beds during spells of dry weather.

Water should be applied in the form of a light spray. During the first two weeks of plant growth it is essential that the surface soil be kept comparatively moist at all times, for at this stage a few hours of hot sun, after the soil has become dry, will be sufficient to kill most of the plants. Where irrigation is used in growing the general crop a system of overhead spray nozzles has been found to give excellent results.

As has been previously mentioned, great care must be taken to remove all weeds and grass that may appear among the young plants. In every case, before undertaking the process of weeding the bed, it is most important to water thoroughly. This will prevent any serious injury being done to the roots of the tobacco plants.

One of the most injurious insects to be guarded against in the cultivation of the seed bed is a flea-beetle. The injury to the plants by this insect may be prevented by the use of a light spray of Paris green. The mixture should be made at the rate of 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water, which should be kept constantly stirred when in use. The same remedy can be applied in the case of the hornworm, where the seed bed is not inclosed or covered.

A very satisfactory fertilizer consists of 1,000 pounds of cotton seed, 1,000 pounds of cotton-seed meal, 300 pounds of carbonate of potash, 700 pounds of fine-ground bone, and 800 pounds of lime to the acre. The cotton seed should be put on the field after it has been plowed and three weeks or one month before it is finally prepared for transplanting. Wherever it can be obtained cow-pen manure should be used broadcast at the rate of 20 to 25 loads per acre. Cow-pen manure promotes very rapid growth and often becomes the means of securing a good crop of tobacco on land badly infested with nematodes. This kind of plant food enables the plant to throw out new roots faster than the nematodes can destroy the old ones.

When produced for wrapper purposes the Sumatra variety of tobacco is usually grown under shade. The purpose of the shade is to protect the crop from insects and other dangers and by reason of reducing the light to secure a thin leaf. The effect of the shade is also shown in influencing the humidity of the atmosphere and the temperature. The plants under shade show a much more rapid growth than the outside tobacco, and the leaves are finer, very thin and elastic, and with very small veins. Such characteristics as these in wrapper tobacco are desired by manufacturers.

Where no cover crop is grown during the winter the land should be plowed frequently and kept thoroughly stirred. This destroys many of the nematodes, and in that way greatly reduces the damage due to these insects the following year. This constant cultivation also prevents, to some extent, the depredations of the thrips; it prevents the growth of grass and weeds, which serve as host plants for this insect.

The preparation of the soil for Sumatra tobacco must be thorough and complete. The soil should be thoroughly pulverized by successive plowing and harrowing, and reduced to a fine condition before transplanting. Deep plowing and subsoiling causes a retention of moisture in the soil if the season is too dry, and at the same time affords the best opportunity for proper drainage if there is an excess of rainfall during the growing season. The disk plow and disk harrow have been used very successfully in the preparation of tobacco soils, particularly where the content of clay is comparatively small.

When transplanting the young plants from the seed bed to the field, it is desirable to make a selection of the best and most vigorous plants in the seed bed. At this early stage of growth the most vigorous plants, having the largest and best-shaped leaves, can be very easily distinguished by the grower and selected for the field.

The ordinary distance for Sumatra under cloth is 3 feet 3 inches apart for rows and 12 inches apart in the row. Under slat shades the distance between the plants in the row is usually increased to about 14 inches.

Before removing the young plants from the seed bed, the bed should be thoroughly watered and the plants taken out with all possible care. In setting the plants in the field care should be taken to avoid bending and doubling the roots, and the necessary application of water should not be overlooked. It is often found beneficial, just before transplanting, to water the soil where the plant is to be set, and to water again shortly after transplanting.

The cultivation of the crop should include the removal of all weeds from the field, particularly during the early stages of growth, and a thorough cultivation of the soil at frequent intervals in order to keep a loose mulch on the surface of the soil. It is usually the custom to hoe the young plants twice and to use some form of cultivator at least once a week during the remainder of the season until the plants have become too large for cultivation. In many instances it has been found desirable and practicable to cultivate the tobacco until shortly before the top leaves are taken off. In dry seasons this serves to retain the soil moisture by preventing excess evaporation due to soil capillarity.

When the plants begin to bud, all except the individual plants saved for seed purposes should be topped. No very definite rule can be given for this process, but it is the usual custom to break off the top of the plant just below the first seed sucker. The height of topping must be largely governed by the local soil and climatic conditions.

It is necessary to remove the suckers before they reach sufficient size to seriously injure or dwarf the plant or interfere in the development of the leaves. In most cases it will be found necessary to remove the suckers two or three times, and more frequently if the season is one which promotes rapid growth. If seed is to be saved on any of

the plants, the flower cluster should be covered with a light and strong paper bag before any of the flowers blossom out, in order to prevent cross-fertilization. The bags should be kept in good condition and not allowed to injure the top of the plant in any way. They should remain over the flowers until a sufficient number has been fertilized to produce a good supply of seed.

The time for harvesting will depend to a considerable extent upon the season, but the ripeness of the leaves can be distinguished by the development of irregular, light yellowish colored patches over the surface and a thickening and crumpling of the body of the leaves. The leaves should be harvested before they become overripe, and it is the usual practice to pick them at three or four different periods, the lower leaves maturing first, the middle leaves next, and the top leaves last, generally allowing from six to eight days between each picking. After picking, the leaves are carried to the curing shed in baskets made for this purpose and are strung on 4-foot laths specially arranged for them at the rate of 30 to 40 leaves to the lath. The leaves are arranged back to back and face to face, and are regularly strung on the cord attached to the lath. The laths are then hung in the curing shed, where the leaves are allowed to thoroughly cure out.

When the tobacco is primed from the stalk it should not take more than three weeks to cure; when it is hung on the stalks from four to six weeks are necessary. The manipulation of the curing barn is governed entirely by the condition of the weather and the nature of the tobacco, so no fixed rules can be given. However, in a general way it can be said that the barn should be opened during the day and kept closed at night. If there are frequent showers and but little sunshine, the barn should be kept closed and small fires started, distributed throughout the building. These fires should be continued as long as it is necessary to dry out the entire barn of tobacco. Where charcoal is not available, wood which has as little odor and as little smoke as possible should be used. It is very important to dry out the barn without giving the tobacco any foreign odors. To obtain the best results the tobacco should become moist and be fairly dried out once in every twenty-four hours.

When the midribs are thoroughly cured the leaves are ready to be taken to the packing house. To get the tobacco in condition to handle, all the ventilators should be left open for one night, opening them about 6 o'clock in the evening. Unless the night is a dry one, the tobacco will soften before morning and be in condition or "good order;" that is, it will have taken up sufficient moisture to make it soft and pliable. The barn should then be tightly closed, in order to retain the moisture, and the leaves taken from the laths and tied into hands of convenient size. The bottom, middle, and top leaves should be kept separate in the barn. After the tobacco has been

taken down and packed it should be taken at once to the warehouse for fermentation.

The fermentation of the tobacco is to be done in bulk, and this sweating process must be watched with unusual care in order to prevent disaster to the crop. It is necessary to turn the bulk several times during the process of fermentation in order to keep the temperature at the desired point. The object of turning the bulk is to reverse its construction, thereby bringing the top, bottom, and outside layers into the middle of the new bulk. This plan will permit a uniform fermentation of all the tobacco in the bulk. A convenient and practical size of bulk contains from 2,000 to 3,000 pounds. The temperature of the center of the bulk should in no case be allowed to rise above 120° F., and after the temperature falls from 8 to 10 degrees the bulk should be turned. The desirable maximum temperature is 115° F. It takes usually from six to eight weeks to complete the process of fermentation. After fermentation the tobacco must be sized, sorted according to the different market grades, tied up in hands, and packed.

CONNECTICUT HAVANA TOBACCO.

There is a very limited amount of plant food in tobacco seed on account of the small size of the individual seed, so that the reserve material for the nourishment of the young plants is soon exhausted; consequently the tobacco seedlings are forced to prepare their own food much sooner than is the case with most other crops. For this reason it is absolutely necessary for tobacco growers to get the soil and plant food in the seed beds in the best possible condition for use by the young plants in order to aid the slow-growing young plants during the critical period of the first stages of growth. The seed beds should be located so that they will get all the benefit possible from the warm rays of the sun during the early spring days, as well as protection from the cold north and northwest winds prevalent at that time of the year. A southern slope where good drainage can be secured is preferable, and a good, rich, and friable soil is desirable for the tobacco seed beds.

As a rule 200 square feet of seed-bed space should be provided to furnish sufficient seedlings for an acre of tobacco, although if the tobacco is to be transferred at different periods a less area will be found to be sufficient. The seed beds are generally 8 feet wide and as long as is necessary to furnish sufficient seedlings for the field. They are usually laid out from east to west.

The framework of the seed bed is usually made of 2 by 12 inch boards, set in the ground from 3 to 4 inches, one side being sunk 2 inches lower than the other in order that the sash may lie over the

top of it in a slanting position, so that the plants will receive all of the sunlight possible.

The best method of covering the bed is by means of glass in sash about 3 feet wide by 8 feet long. These sash are laid over the top of the framework and of course can be removed at any time when it is necessary. In some cases heavy cheese cloth or tobacco cloth is substituted for the glass covering, but the temperature of the beds can not be regulated so well as with the glass cover, and the cloth should not be used where very early plants are desired. It is claimed by old tobacco growers, however, that the plants raised under cloth are more hardy than those raised under glass, and it is a frequent practice to grow the early plants under glass and the later seedlings under cloth. In Plate II, figure 2, are shown the cloth tent seed bed, the cloth-covered cold-frame seed bed, and the glass-covered seed bed, which are most practicable and successful for the raising of seedlings.

When it is necessary to water the seed bed the sash are removed temporarily and the water is applied in the form of a fine spray. As soon as the watering is completed the sash are replaced in their original positions. If it becomes necessary to air or cool the beds one or more sash can be raised until the desired object is accomplished.

The soil for the seed bed should be a light sandy loam, as free from weed seed, fungous diseases, and insect pests as possible. It has been found that by sterilizing the soil used in the seed bed the expense of weeding the beds can be done away with. The sterilization of the seed-bed soil results in the production of better plants than are grown in soil which has not been sterilized and also destroys the fungous spores which frequently interfere with the successful raising of young plants. In Plate III, figure 2, is shown a simple and practicable method of sterilizing the soil with steam. The upper 6 inches of the soil in the seed beds is removed and placed in an ordinary wagon box, in the bottom of which three perforated pipes are laid and attached to a steam boiler. The sterilization process requires about 40 minutes for each wagon box of soil, the time being determined by placing a potato in the soil and supplying steam until the potato is baked. A large quantity of surface soil in the seed beds can be sterilized in this manner in a comparatively short time with little expense.

A successful method of heating seed beds is by the use of fresh horse manure. In this case the beds should be dug out 2 feet deep about a week before the time for sowing the seed. The fresh manure should be packed in this space to a depth of 1½ feet and covered with 6 inches of the sterilized soil. Another successful method of heating the seed bed is by the use of hot-water or steam pipes, laid around the sides of the bed or under the surface of the soil. General experience has proved, however, that the manure beds are equal in value, if not superior, to the artificially heated ones, mainly from the fact that the

heat is distributed evenly through the soil in the seed bed, while in the case of hot-water or steam pipes the surface of the bed or the air space is likely to be hot while the soil may remain cold and in poor condition for the growth of the young plants.

The soil for the seed beds should be fertilized with a highly nitrogenous fertilizer, the one most commonly used being cotton-seed meal in combination with a complete fertilizer containing phosphoric acid and soluble potash. This fertilizer should be thoroughly worked into the soil.

In preparing the soil for the sowing of the seed, it should be most carefully handled, so that at the time of sowing it is in a fine, loose, and friable condition, with an even surface. As the tobacco seed is very small, it is necessary to have the soil in the finest possible tilth in order to present a uniform condition for the seed. During the growth of the young plants it is well to sprinkle over the beds a light dressing of nitrate of soda, dissolved in water, after which it should be washed into the soil with a light and fine spray of water. It is sometimes found desirable to add a light application of phosphorus, in the form of ground bone and carbonate of potash, if the soil is found to be deficient in these elements of plant food. It is the usual practice in the North to sprout half of the quantity of seed used for sowing in moist but not too wet apple-tree punk or rotted cocoanut fiber about one week before the time for sowing the bed. For this purpose the seed is thoroughly mixed with the punk and placed in a glass jar, which should be kept in a warm room. The seed will sprout quickly in this medium, and it is probable that earlier plants can be secured from such sprouted seed than from sowing the dry seed alone. The sprouted seed should be sown about the time the sprouts are one-eighth to one-fourth inch in length. Many growers sow the sprouted seed as soon as the seed coats burst and the sprouts appear. If the sprouts become too large they will be injured during the process of sowing. An equal quantity of dry seed should be mixed with the sprouted seed when the beds are ready for sowing.

It has been found by comparative tests made by the Bureau of Plant Industry that in most cases the dry seed produces plants about as early as the sprouted seed, and the plants from the dry seed are more uniform in size and apparently more hardy than those raised from the sprouted and dry seed combined. In order to get an even distribution of seed over the seed bed in sowing, it is a good plan to mix the dry seed and the sprouted seed with several times its bulk of land plaster or gypsum, or, if this is not obtainable, corn meal or ashes, so the seed can be sown more evenly over the bed. One to two tablespoonfuls of seed should be used for every 100 square yards of seed-bed surface.

After sowing the seed it is desirable to pack the surface of the bed carefully with a roller or heavy plank, in order to press the soil closely about the seed. Another good plan is to cover the seed by lightly raking the surface with an ordinary garden rake, and this method is preferred by many experienced growers. It has been found in the experiments of the Bureau of Plant Industry that the light seed is undesirable and in every case should be separated from the heavy seed and discarded. In order to make a thorough and complete separation, it is necessary to use some form of a wind-blast machine which will blow out the light seed without throwing out the heavy seed at the same time. In Plate IV, figure 1, is shown a satisfactory seed separator, by the use of which the light seed can be separated from the heavy seed and discarded, and the heavy seed used for sowing the seed beds. The heavy seed produces the most vigorous and uniform young plants in the seed beds, as shown in Plate IV, figure 2, and these plants are most desirable for use in the case of all varieties of tobacco.

The Havana seed variety of tobacco is usually sown in the seed bed from the middle of March to the middle of April, and the plants are ready for setting out from these beds from May 10 to June 10.

One of the most important points in the raising of a successful crop of tobacco is the care of the seed bed in the production of the seedlings. It is necessary to water the seed bed frequently, usually once or twice every day during the early stages of growth. If the beds are artificially heated, warm water should be used for this watering process, as cold water cools the beds and checks the growth of the young plants. The surface of the seed bed should not be allowed to become dry, as a few hours of dry surface will kill all of the young plants. The water should be supplied in the form of a light spray, in order not to disturb the seed or the young plants in the bed or to pack the soil so that in drying it will cake and injure the plants.

The temperature of the hotbeds should be carefully regulated, and in no case allowed to rise above 100° F. during the day or fall below 70° F. during the night. If it is possible to maintain an even temperature the plants will make the most rapid growth, but it is a question whether they will be as hardy as when subjected to the fluctuating temperatures corresponding to the natural changes between night and day. The beds can be cooled when necessary by raising the sash if the temperature rises, or the temperature can be raised at night by using lanterns set 5 or 6 feet apart in the seed bed and by covering the sash with heavy cloth, such as ordinary blankets, in order to retain the heat. After the young plants reach the proper size for setting out, usually from 5 to 6 weeks after sowing in the seed bed, the sash can be taken off most of the time during the day and the beds watered only when the plants begin to wilt. If the plants come up too thick

in any portion of the seed bed, they should be thinned out by using an ordinary garden rake and pulling it through the thickly set plants. Sufficient plants will be removed in this way, and those which remain will not be injured by the thinning process, but will be benefited by the stirring of the surface soil. It is also necessary to keep out all weeds, carefully pulling them as soon as they appear among the tobacco plants. Before pulling the weeds, the beds should be thoroughly watered. If flea-beetles or other biting insects attack the young plants in the seed bed, the plants should be sprayed with a Paris green mixture at the rate of 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water. If fungous diseases begin to grow in any portion of the seed bed, it should be thoroughly aired by raising the sash during the day, and if this method does not check the growth of the fungus the beds should be sprayed with a solution of formalin—1 part of formalin to 2,000 parts of water. An application of lime dusted over the beds will also assist in preventing the spread of fungous diseases.

The preparation of the field for the plants should be begun in the autumn, if possible, by plowing the land 2 or 3 inches deep and sowing a cover crop, such as vetch or some other legume. These leguminous cover crops not only prevent washing and loss of fertility during the heavy rains of the fall and winter, but increase the fertility of the soil through the addition of the nitrogen in the tubercles of these plants and by reason of their extensive root development, which tends to break up and put the soil in the best possible tilth for the young plants. In the spring the land should be replowed, care being used to see that the cover crop is thoroughly plowed under, with an application of well-rotted stable manure at the rate of 12 to 15 tons to the acre.

In addition to the use of stable manure, it has been found that the following or a similar fertilizer should be used in order to secure the best results: One ton of cotton-seed meal, 200 pounds of carbonate of potash, 500 pounds of starter, and 1 barrel of lime to the acre. This commercial fertilizer should be sowed on the land after plowing and worked into the soil with a disk or by some other means of thorough stirring before the young plants are transplanted into the field. When the young plants are pulled from the seed beds the bed should be thoroughly wet down before pulling, in order that as little injury to the plants as possible may be inflicted during the process of pulling. The plants are usually set out with a tobacco setter, such as is shown in Plate III, figure 1. If possible, it is desirable to transplant after a shower or during a moist spell of weather, as the hot sun on the young plants in the fields is likely to cause considerable injury. Immediately after transplanting, the young plants should be dusted with a bran mash and Paris green mixture made by mixing thoroughly 1 pound of Paris green with 100 pounds of bran. This mixture can be applied to

the plants by dusting through a perforated tin box, or in some cases a small fertilizer sower is used for this purpose.

In transplanting the young plants from the seed bed it is desirable to make a selection of the best and most vigorous plants. At this early stage of growth the differences in shape of leaf can be detected by an inspection of the seedlings. For the Havana Seed variety the plants should be set in rows 3 feet 3 inches apart, and the plants should be set 18 inches apart in the row. If the plants are set by hand great care should be used not to bend or otherwise injure the roots of the young plants, as such injury may result in a diseased condition of the plant, making it almost worthless for wrapper purposes.

In cultivating the field a shallow or surface cultivator should be used and the soil kept stirred frequently in order to conserve soil moisture, as well as to remove all weeds. It is usually found necessary to hoe the field once or twice during the early stages of growth in order to remove all of the weeds and to loosen the soil around the young plants and keep it in the best possible condition for their most favorable growth.

When the plants begin to bud all except the individual plants saved for seed purposes should be topped. No very definite rule can be given for this process, but it is the custom to break the tops off the plants just below the first seed sucker. As a rule the height of topping must be governed by local conditions, such as the soil fertility and the season. In most cases two or three of the top leaves are removed in topping. It is necessary to remove the suckers before they reach sufficient size to seriously injure or dwarf the plant or interfere with the development of the leaves. It will usually be found necessary to remove the suckers two or three times during the season in order to keep the plants free from these injurious branches.

It has been found in the tobacco-breeding investigations that by selecting seed from plants having few suckers, sucker-resistant types of tobacco can be secured, and it is recommended that in the case of all of the wrapper varieties of tobacco, particularly the Havana Seed tobacco, such a plan of seed selection be followed. In saving seed from carefully selected plants the flower clusters should be covered with a light and strong paper bag before any of the blossoms open, in order to prevent accidental cross-fertilization. These bags should be of light but strong paper, and should be kept in good condition and moved up the stalks occasionally so as not to allow the bags to injure the tops of the plants in any way. These bags should remain over the seed head until all of the flowers that are to be used for seed-saving purposes have been fertilized, after which the bags can be removed and the seed allowed to mature in the open.

The time for harvesting this variety of tobacco varies with the season, but the ripeness of the leaves can be distinguished by the devel-

opment of irregular, light yellowish colored patches over the surface and a thickening of the body of the leaves. By crumpling the leaf, if the surface breaks in straight lines, or "cracks," as the old growers are accustomed to call it, the leaf is said to be in proper shape for cutting.

The plants are usually cut with a regular tobacco hatchet or knife and are strung on laths, as shown in Plate V, figure 1. Five or six plants are usually strung on each lath, after which they are hauled to the sheds in wagons specially prepared for this purpose. A wagon with special rack arranged for transporting the plants from the field to the curing shed is shown in Plate V, figure 2. These laths are usually 4 feet in length, and are so hung in the curing shed that a space is left between each plant in order to get a circulation of air. A common type of curing shed filled with tobacco is shown in Plate VI, figure 2.

The curing process requires as a rule from 4 to 6 weeks. The manipulation of the barn or curing shed during this period is entirely governed by the conditions of weather and the nature of the tobacco, so that no fixed rules can be given. However, in a general way it can be said that if the barn is filled with green tobacco and the weather is hot and dry the ventilators should be open most of the time for about 3 days, by which time the tobacco should begin to yellow. The ventilators should only be closed to prevent too rapid curing during this period. The barn should then be opened at night and kept closed during the day. This is done to prevent too rapid curing, which destroys the life of the leaf and produces uneven colors in the tobacco. If there are frequent showers and but little sunshine the barn should be kept closed, and if there are indications of pole-burn or pole-sweat, small fires, at least two in every bent in the shed, should be started. In order to dry out the tobacco in as short a time as possible, these fires should be distributed throughout the shed and the tobacco above the fires protected by hoods. The best material for making these fires is probably charcoal or coke, but if these two materials can not be used soft pine wood may be found to be satisfactory. In no case should hard wood be used, as certain odors are given off which it is impossible to get out of the tobacco, and these injure the quality and the sale of the crop. To get the best results, the tobacco during the curing process should be kept fairly moist and fairly dried out once in every 24 hours.

After the curing process has been finished the tobacco is usually sorted according to grade and color as laid down by the tobacco trade. The tobacco is then arranged in hands and packed in cases, where it is allowed to go through natural fermentation, or it is placed in a room which can be heated and is there put through a forced sweat. If the natural fermentation takes place it usually does not begin until the warm weather of the succeeding summer. Great care must be used

in the fermenting processes that the tobacco is not damaged by the spread of fungous diseases, mold, or other causes of injury to tobacco in cases. The cases are usually arranged to hold about 350 pounds of tobacco.

CONNECTICUT BROADLEAF TOBACCO.

The methods of sowing the seed, preparation of the seed beds, and treatment of the beds are practically the same for the Connecticut Broadleaf as in the case of the Connecticut Havana variety. Many of the growers in the Connecticut Valley prefer the tent cover for the seed beds for this variety, two forms of which are shown in Plate II, figure 2. The advantage in the cheese-cloth or light-muslin cover for the seed bed lies in the fact that plants grown under such conditions are as a rule more hardy than plants raised under glass. As the Broadleaf plants make a very rapid growth in the seed bed and field, hotbeds for the production of early seedlings are not as essential as with other slower growing varieties. To sow the seed mix one tablespoonful for every hundred square yards of seed bed with 2 quarts of ashes or meal in order to get an even sowing, and lightly rake the surface of the bed so as to barely cover the seed. If the seed is covered too deep, it will not germinate.

The seed bed should be kept moist, but not too wet, as too much water not only injures the seed, but favors the development of fungous diseases. In about two weeks after sowing, the young plants will appear, but at this time they make a very slow growth, as the plant food in the seed has been exhausted and the plants must meet new conditions. At this stage, if the surface of the bed dries out, the young plants will be killed, so that it is absolutely necessary to use the greatest possible care in watering the beds. After the young plants have developed root systems and become established for independent growth they make a very rapid growth, and it is usually desirable to apply liquid manure. If the seedlings begin to turn yellow, it is a sign that more plant food is necessary, and this can be applied in liquid form. The young plants should be set out when the leaves are about five inches long. Large plants are not desirable, as they grow spindling, while very small plants are likely to die after transplanting if any unfavorable conditions develop. In transplanting, the beds should be thoroughly watered before pulling the plants in order to avoid disturbing or injuring the roots. After pulling the plants they should be placed in a basket, roots downward, and set in a shaded, cool place until set out in the field.

The preparation of the land for planting should be thorough, and the soil should be in as good tilth as possible. Cover crops, such as vetch, are desirable for plowing under. A disk cultivator is a good implement to fine the surface soil, after which the land should be fitted

with drag and harrow, in order to get the surface as level and fine as possible. The land is usually fertilized with well-rotted barnyard manure, at the rate of from 8 to 12 tons per acre, plowing it under in the spring. Frequently tobacco stems, at the rate of from 500 to 600 pounds per acre, are used as a fertilizer in the Broadleaf sections. Most crops of Broadleaf tobacco are grown on these fertilizers alone, but in recent years the growers have begun to apply about 1 ton of cotton-seed meal, 200 pounds of carbonate of potash, and from 1 to 2 barrels of lime per acre in addition to the usual tobacco starter.

The seedlings of the Broadleaf variety are usually set in rows 4 feet apart and the plants from 22 to 24 inches apart in the rows. In all cases water should be used in transplanting, even if the ground be moist. If the plants are set by hand, one person distributes the plants at the proper distance along the rows, followed by a man or boy who, with a round stick, makes a hole for the plants. A third person sets the plants in the holes and presses the soil firmly about the roots, leaving the surface of the soil as loose as possible. As the plants are set in the holes, a cupful of water should be poured into the holes, and some growers prefer to add water to the plants directly after they are set, although this practice leaves the soil about the plants in such condition as to bake, especially during a hot, dry day.

The object of the cultivation of the field is to keep the soil in as good condition as possible and to prevent the growth of weeds and the loss of soil moisture. In most cases a loose mulch should be maintained by frequent, shallow, level cultivation. As the plants grow, the soil should be stirred with a hoe around the plants. One of the best cultivators is called the Prout hoe, which is adjustable to the width of the rows, the small shovels leaving the surface with a fine even texture.

The topping process is necessary in order to direct the strength of the plant into the development of the leaves. After topping, the surface of the leaves very rapidly increases, the leaves thicken, and the ripening processes are hastened. The Broadleaf plants are usually topped below the first large sucker. If it is found desirable to hasten the ripening process, the plants are topped low, while if necessary to prevent the development of too thick leaves the plants should be topped high. Usually the topping process is delayed until most of the flower buds appear, so that the topping can all be done in one operation, but many growers prefer to remove the buds as soon as they appear, going over the field later and topping to the desired height. As soon as the suckers appear they should be broken off, and in order to do this effectively it is necessary to go over the field once a week after the plants have been topped.

The time to harvest the crop can only be determined by experience with the strain which is grown. As a rule, a ripe leaf has a rough feeling to the touch, and there is a change in the color of the leaf from

a dark to a lighter green; also, by folding the leaf between the fingers a ripe leaf will break easily. In the Broadleaf variety the plants are usually cut, and as all the leaves on a plant are not ripe at one time, it is necessary to harvest the crop when the majority of the leaves are in the proper condition or about the time that the middle leaves are ripe. Overripe leaves lose their elasticity and strength, and are not suitable for cigar wrappers. The plants are speared on 4-foot laths, using a detachable iron spearhead fitted in the end of the lath, as shown in Plate V, figure 1, placing from 4 to 6 plants on each lath.

The Broadleaf tobacco is air cured, the process taking about six weeks. After harvesting, the plants are immediately hung in the barn, and the temperature and humidity of these sheds must be closely watched and controlled by means of the ventilators. If the leaf cures too rapidly the ventilators should be opened on moist days and nights and closed on dry days. If the curing process proceeds too slowly or the tobacco is liable to injury from pole-burn or other fungous diseases, the ventilators should be opened on dry days and closed on moist days and at night. In long-continued damp spells of weather, when the tobacco can not be dried out by opening the ventilators during the day, small fires of soft pine or charcoal should be used to drive off the excess of moisture and raise the temperature in the barns.

The Broadleaf tobacco is usually fermented in cases holding about three hundred pounds, the hands of tobacco being laid in these cases with the butts of the hands on the outside and the tips in the center. The tobacco is then pressed down under moderate pressure, the tops of the boxes screwed on, and the cases kept in a room having an even temperature.

CUBAN TOBACCO.

Cuban tobacco is grown without shade when used as a filler for domestic cigars. The percentage of wrappers in this outdoor crop is not large, but when the leaves are primed the percentage of wrappers is considerably increased. The preparation and care of the seed beds and methods of cultivation are about the same as in the case of the Sumatra variety. The rows in the field are arranged about 3 feet 4 inches apart and the plants set about 14 inches apart in the row. A greater distance results in thick, heavy leaves. If the plants are set too close the leaves are too thin and lacking in body for filler purposes.

No definite rule can be laid down as to the proper number of leaves to be left on the stalk when the plants are topped. This number varies with the height of the plant and the climatic conditions during the season. From 14 to 16 leaves, however, are considered desirable during the ordinary season. The suckers begin to appear very soon after topping and should be removed every 8 or 10 days or once a week when rains are frequent.

Worms are usually very troublesome on this variety of tobacco and must be picked off and destroyed as soon as they appear, or they can be poisoned with a very light spray of Paris green mixture. The "powder gun" has come into general use and is rapidly replacing the spray pump for poisoning the hornworm and budworm. The growers who still employ the spray pump use 1 pound of Paris green and an equal quantity of quicklime to 100 gallons of water, this being sufficiently strong to kill the hornworms without injuring the leaves. If a stronger solution is used there is danger of burning the leaves, so that patches of green will appear after curing. A mixture of 1 pound of Paris green to 30 pounds of lime or land plaster is recommended for use in the powder gun.

The manner of harvesting the southern Cuban tobacco is essentially the same as that practiced with the Connecticut Havana Seed tobacco. The number of plants to the lath, however, may be increased to 8 or 10, where the growth is comparatively small.

Some growers prefer to prime the Cuban tobacco. This process is more expensive, but a thinner leaf is obtained, which makes it possible to use a certain percentage of leaves for wrapper purposes. There are no advantages in this system over the present method of cutting the plants so far as the production of a filler leaf is concerned.

Where the soil has been abundantly fertilized and the season is favorable, a profitable second crop of filler can be grown, which is commonly called a "sucker crop." A week after cutting, all the suckers should be broken off the old stump with the exception of one, which is to be allowed to remain and mature. It should be handled in exactly the same way as the original crop. The sucker crop ordinarily produces about one-half the yield of the main crop. Insects are always very much worse late in the season and become very troublesome in the sucker crop.

ZIMMER SPANISH AND LITTLE DUTCH TOBACCOS.

The preparation and care of the seed bed for Zimmer Spanish and Little Dutch varieties should be the same as given for Connecticut Havana tobacco. The preparation of the soil and the methods of transplanting and cultivating are the same as those given for Connecticut Havana. The plants should be set in rows 3 feet apart and the seedlings set from 15 to 20 inches apart in the rows. The plants should be topped so as to leave about 16 leaves for each plant. The average yield of the Zimmer Spanish variety is about 600 pounds to the acre, while the yield of the Little Dutch variety is considerably less. The methods of harvesting, curing, and fermenting are essentially the same as those for the Connecticut Havana variety.

MARYLAND SMOKING TOBACCO.

The seed bed should be located on a dark, friable, loamy soil with a southern exposure. The plants may be easily watered if the seed bed be located near a brook. The old method of burning the seed bed has been largely abandoned, but, if used, care should be taken to burn only small timber and brush. A large quantity of ashes is detrimental to the growth of the young plants. All trees within 30 or 35 feet should be cut down and piled on the north and west sides of the seed bed for a partial protection against the cold winds.

The proper time for preparing and sowing the seed bed is from February 1 to March 30. The bed should be spaded to a depth of 4 or 5 inches, and all roots and tufts carefully removed. The soil must be thoroughly pulverized with garden hoes, hand rakes, or other suitable implements. Before the last stirring an application of a highly nitrogenous fertilizer should be evenly distributed over the bed and thoroughly incorporated into the soil. A mixture of 50 pounds of nitrate of soda, 40 pounds of fine-ground bone, and 10 pounds of carbonate of potash, applied at the rate of 30 pounds per square rod, is highly recommended.

Sow the seed at the rate of two tablespoonfuls to the square rod. It can best be uniformly distributed over the bed by mixing with wood ashes or land plaster, dividing it into two equal parts, and sowing half of it over the bed crosswise and the other half lengthwise. The sides of the bed should be from 8 to 10 inches high, and wires 3 feet apart should be stretched across it. The beds can be covered with light cheese cloth or tobacco-bed cloth, after the seed has been sowed. The covering serves as a protection against the ravages of the flea-beetles and other insects, provided there are no open spaces around the bed. All weeds and grass should be removed. It is seldom necessary to water the plant beds, except in the case of unusually dry weather. Water at this time is very essential. It should be applied as in the northern seed beds, but less frequently, it being seldom necessary to water the beds more than twice a week.

In most cases it is advisable to replenish the plant food with a top-dressing or fertilizer of the same composition as that of the first application. This should be applied in liquid form, wherever it is possible to wash it in thoroughly; otherwise it is most important to top-dress the beds only during hot, dry days. The top-dressing should be used when the plants are from 2 to 3 inches high. Where cloth is not used for a covering, the beds must be closely guarded against the attacks of the flea-beetle. When this insect first makes its appearance the plants should be treated with Paris green at the rate of 1 pound to 30 pounds of land plaster. The cloth covering should be removed from the beds

at least a week before transplanting to prevent the injurious effect of the radical change from the seed bed to the open field.

Maryland tobacco is transplanted from May 15 to June 15. Care must be used to wet the seed bed down thoroughly before drawing the plants, thus protecting the roots from injury. The mottled or mosaic tobacco, so common in Maryland tobacco fields, is frequently due to the practice of drawing the plants when the soil is not thoroughly moistened. This variety should be set in the field in rows 3½ feet apart and the plants 20 to 35 inches apart in the row.

Tobacco should be preceded by a leguminous crop of some kind, hairy vetch being highly recommended for this purpose. In addition to the nitrogen from the leguminous crop a fertilizer rich in potash and containing a moderate amount of phosphoric acid should be added before transplanting. The best stand is obtained in the field where the land has been plowed deeply and harrowed several times, thus leaving a thoroughly pulverized soil for the reception of the plants. The methods of cultivation, topping, suckering, and harvesting are essentially the same as in the case of the Connecticut Havana variety.

NORTH CAROLINA, TENNESSEE, AND VIRGINIA TOBACCOS.

The methods of sowing the seed and of preparing and caring for the seed bed are the same in the case of North Carolina, Tennessee, and Virginia tobaccos as those used by the Maryland growers. The seed, however, may be sown at least a month earlier than in Maryland.

Two systems of harvesting are in general use, both of which have certain advantages. One of these systems is to prime the leaves as fast as they ripen and string them on laths, allowing 30 to 32 leaves to a lath. The other and more common system is to cut the entire stalk and cure the leaves on it, as is done with the Connecticut Havana variety.

The North Carolina, Tennessee, and Virginia tobaccos are usually flue cured or fire cured, for which purpose a special type of barn is used. The essential points of this barn are that it be practically air-tight and provided with one or two furnaces having flues leading up through the center of the barn, giving a large heating surface. There should be at least two small ventilators on or near the top of the barn.

As soon as the barn is filled with tobacco, fires should be started and the temperature raised to 90° F., where it should remain from 24 to 30 hours, during which time the tobacco becomes a uniformly bright yellow. The next step in curing is to raise the temperature from 90° to 120° F. for 15 to 20 hours. This process is commonly known as "fixing the color." Then the temperature may be increased gradually to 125° F., at which point it should be maintained for about 48 hours. By this time the leaves should be almost, if not entirely, yel-

low, but the stalk will still be green. In order to cure out the stalk, the temperature can be raised to 175° F., at the rate of 5 degrees an hour, where it should remain until the stalks are thoroughly dried. Great care must be taken during the entire process of curing not to allow the temperature to fall, for a lowering of the temperature during the process of curing invariably produces discolorations in some parts of the leaf.

WHITE BURLEY TOBACCO.

The seed bed should have a slightly southern exposure in order to get the benefit of the warm rays of the sun in the early spring, and the beds should be protected from cold winds. The best soil for the White Burley tobacco is a rich, friable, virgin loam or sandy soil. The best plan is to burn and prepare the seed bed on old sod lands. Many farmers select a spot in a vegetable garden and cover it with virgin mold taken from the woods, and sow it, after thoroughly burning the land until it has a reddish or brick-like appearance, when it should be spaded up and thoroughly chopped over with hoes until it is fine and even. The ashes should not be raked off, but should be thoroughly mixed in with the soil. As soon as the ground can be worked in the spring, it should be lightly spaded and thoroughly loosened to a depth of 2 or 3 inches with harrows or hand rakes. When in good condition, it should be marked off in beds about 4 or 5 feet wide and seeded. It is the usual custom with this variety to use a heaping tablespoonful of seed for every 100 square yards of seed bed. After sowing, the best plan is to run a heavy hand roller over the bed or press it with a board or with the feet. As a rule, the bed is tramped over with the feet until the surface is packed. The seed bed is usually protected by a canvas covering to prevent the ravages of flea-beetles and to keep the bed moist and warm.

The preparation of the land is generally begun in the month of March, the usual plan being to turn under the soil with a 2-horse plow to a depth of about 8 inches. About the middle of April a revolving disk or harrow is run over the land in order to cut the sod to pieces, after which the field is smoothed over with a slab drag. It is very rare for fertilizers or manure of any kind to be used in the White Burley districts. Tobacco stalks and trash from the barnyard are preferred to any other fertilizer for this tobacco. Owing to the fact that the crop is grown for two years and the field is then put in rotation with other crops, the fertility of the soil is maintained.

The tobacco plants are usually set after a shower, or when there is no rain they are set out in the afternoon. The land is cultivated with a bull-tongue cultivator during the first week or so, and then cultivated every week with a double-shovel cultivator as long as it is possible to do so without injury to the plants. As soon as the cultivation is

finished the plants are topped, leaving from 16 to 20 leaves on each plant. From four to five weeks after topping, the tobacco is usually fully ripe and the plants are cut with a tobacco cutter or butcher knife. The stalks are split down the middle and strung on sticks 4½ feet in length, after which they are taken to the tobacco barn and hung 12 inches apart on the tier poles. When fully cured, the tobacco is sorted, usually into six grades, and the different grades are tied into bundles of from 10 to 20 leaves and packed for the market.

INSECT ENEMIES.

The general subjects of the insect enemies of tobacco and the use of insecticides are considered in Farmers' Bulletin No. 120, entitled "The Principal Insects Affecting the Tobacco Plant," which may be had without cost upon application to the Secretary of Agriculture. In case the seed beds are inclosed or covered, the tobacco is largely exempt from injury by such pests as flea-beetles and hornworms. The tobacco stalk weevil and tobacco thrips are comparatively new as pests. Two accounts of the former have been published and a detailed account of the latter is about to be issued by the Bureau of Entomology, to which office tobacco growers are referred for specific information in regard to methods of controlling insect pests. In the case of arsenicals it is always desirable to use at least an equal quantity of quicklime to prevent injury by free arsenic.

DIRECTIONS FOR SAVING SEED.

In all cases where new seed is taken into a locality it should be thoroughly tested before growing on a large scale. This is especially true of all seed imported from Cuba, Sumatra, Turkey, or other foreign countries. The past few years have witnessed a striking illustration of the effect of using seed direct from tropical regions, such as Cuba and Sumatra, when grown in the northern tobacco districts. The plants grown from this freshly imported seed broke up into many different types, some of which may prove valuable, but most of the types are irregular and undesirable. Therefore it has been a common experience for growers to suffer great losses by reason of the presence of these undesirable types during every season in which the seed was used. This breaking up of type is due to the effect of the change of soil and climatic conditions, resulting in striking variation in the plants grown from the imported seed. The variation is particularly marked where southern seed is taken to northern tobacco districts.

Our experiments have shown that if the seeds from typical and desirable plants in these crops are saved under bag, and thus protected from cross-fertilization, the plants produced from such seed will be uniformly like the parent plants. The uniformity of plants from seed

saved under bag is illustrated in Plate IX, figure 1. The two rows shown in this illustration are from the seed of two plants of different types and all of the progeny are like the parents. The second season it is a good plan to increase the area of plants grown from seed saved under bag, and from the most desirable plants in this crop selections of seed can be made for future general crops. If the crop during the second season shows uniformity of a desirable type, it is advisable to save a large quantity of seed under bag—if possible, sufficient to plant several succeeding crops—in order to provide for a possible failure of seed production in future seasons. Inasmuch as tobacco seed when properly cared for will retain its vitality for from 10 to 20 years, this seed can be safely used, if necessary, for 5 years. The best practice, however, is to save the seed for the following year's crop every season unless some accident should greatly injure the crop.

The grower of all new varieties of seed should test them on a small area before using them for his entire crop. In some cases new seed, when grown under conditions different from those under which the seed was produced, develops plants which are subject to fungous diseases or insect enemies in the new conditions. Therefore it is a wise plan to grow a small area of tobacco the first season and observe the plants carefully in respect to the presence of fungous or other diseases before using them in large fields. In other cases certain fungous diseases are present in the soil, which attack and destroy the varieties imported from other regions. In most cases resistant plants can be found in fields affected by these diseases. The structure or habit of growth of these resistant plants is such as to make them immune to these attacks. The seed of resistant plants should be saved under bag and used for the next year's planting. In this way resistant strains of tobacco which will prove to be immune to the attacks of the various diseases may be secured.

In selecting seed plants several important facts should be taken into consideration. All the plants in the field should be carefully studied and observations made on the shape of the leaf of the different plants, on the variations in size and color of leaves, and on the time of maturity of individual plants in the field.

Plate VIII, figure 2, shows two strains of Connecticut Broadleaf, the larger one from an early parent and the other from a late parent. The number of leaves and the number of suckers should be counted on many plants in the field from which seed is to be saved, in order that an accurate idea may be gained of the extent of variation in the variety as regards these points. As a rule, there is a great variation in all of the important characters which go to make up the type of plants, and individual plants will be found which have desirable shape, size, and color of leaf, which mature early and have an extra large

number of leaves and few suckers. The grower should decide in his own mind on the type of plant which he desires to grow for his crop and should carefully select those plants in the field which most nearly fulfill this ideal.

The flower head on the selected seed plants should be inclosed with a light but strong paper bag just before the flowers begin to open. The proper time to apply the bag is shown in Plate VII, figure 1, and the arrangement of bags is shown in Plate VII, figure 2. It is usually a good plan to remove two or three of the top leaves and suckers just below the flower head. The bag should be tied around the stem in such a way as not to interfere with the growth. It will be found that at this period of growth the plant increases in height very rapidly, and it will be necessary to raise the bag occasionally in order to prevent the flower head from pushing out through the bottom of the bag. For most varieties a 12-pound bag is the most desirable size. This bag should be of strong but light material. The ordinary paper bag found at any grocery store may be satisfactory for this purpose.

When the seed pods have turned brown, indicating maturity, the entire top of the plant should be cut off. The bag should be opened and all of the small and late pods picked off and only the large, heavy, plump, and well-developed seed pods allowed to remain. The bag should then be replaced and the seed head hung up in a dry place where there is a free circulation of air, such as the attic of a house, until the seed pods are thoroughly dried. After this the pods should be picked off from the stem and the seed shelled out. After the seed has been secured, all of the light seed, hulls, and chaff should be removed by the use of a seed separator, as shown in Plate IV, figure 1, or by some form of air-blast machine adapted for this purpose, and only the heavy seed should be retained for planting. The heavy seed should then be placed in dry glass jars and set in a safe place. In this condition the seed will retain its vitality unimpaired for a long period.

In many cases it may be desired to cross an imported with a native variety. The object of such crosses is to secure the improved quality of the imported strains, combined with the hardiness and yielding power of the native varieties. In the case of tobacco such crosses are easily made by the grower. The tobacco plant has a perfectly self-fertile and complete flower, but is easily cross-fertilized. In order to prepare the flower for cross-fertilization, the anthers should be removed from the selected flowers shortly before they open and discharge their pollen. The arrangement of the parts of the tobacco flower at different stages of maturity is shown in Plate VIII, figure 1. The opened flower in the lower right-hand corner shows the proper stage for the removal of the anthers. After an examination of a number of flowers in the field the grower can easily observe the proper time to remove the

anthers so that none of the pollen shall have escaped and fertilized the flower. One easy means of noting this time is to observe the condition of the corolla. The anthers should be removed just before the corolla opens. As soon as the anthers have been removed, a small paper bag should be tied over the flower and allowed to remain for at least one day or until the stigma becomes receptive for pollen. This receptive condition of the stigma is easily noted by the presence of a sticky, viscid substance over the surface. At the proper time for pollination, anthers from the desired imported strain which are just ready to discharge their pollen should be secured. These anthers should be broken open and the pollen carefully rubbed over the surface of the stigma of the flower to be fertilized. As soon as this pollination has been completed, the small bag should be replaced over the flower and allowed to remain there until the end of the season. A small tag should be attached to the flower, giving the name of both parents, as Havana × Sumatra (the first name referring to the female and the second to the male parent), with any other data which would assist the grower in keeping a record of the parentage of the cross.

The best plan which can be followed in the case of crosses is to grow 100 plants of each cross and carefully note the characteristics of the hybrid plants. It will be found that there will be considerable variation in the plants the first season. Seed should be saved from those plants which are most desirable and which show the greatest improvement over the native varieties. The next season a larger area can be planted from this seed; and if the crop is uniformly of the type desired, enough seed can then be selected the second season to plant the entire crop the third year.

HOW TO SECURE GOOD SEED.

1. Save the best plants in the field for seed plants. An early Broadleaf plant of desirable type is shown in Plate VIII, figure 2, in comparison with the ordinary plants, and was selected for seed production on account of earliness. During the cultivation of the crop and the suckering and topping processes a constant search for good plants should be made by growers.

2. When good plants are observed, they should be plainly marked by a tag or rag tied to the plant, so that they may be easily found and to prevent them from being accidentally topped.

3. Place a light, 12-pound size, manila paper bag over the flower heads of the selected seed plants before the first flowers open. Inspect the bags every few days for the first two weeks and raise them up farther on the growing stems, arranging them so as to prevent any injury from crowding in the bag during this period of growth. The extent to which this method of saving seed is now being followed is shown in Plate VI, figure 1.

4. At the end of the season, when the seed pods are ripe, cut off the plants near the ground without removing the bags and hang them up in a dry place. The bags serve to catch the seed which may fall out of the capsules on drying.

5. After the seed has thoroughly dried, shell it out of the capsules and separate the heavy seed for use by the means described in this paper.

6. It would be well for every grower using this method of seed selection to save some seed in the ordinary way and plant it for comparison.

PLATES.

DESCRIPTION OF PLATES.

PLATE I. (*Frontispiece.*) Fig. 1.—Connecticut Cuban tobacco, first year from Cuba. Plants in foreground are freaks and undesirable. They have reached maturity prematurely, and have very few salable leaves. The suckers and flower branches are numerous and large. Fig. 2.—The same field shown in figure 1, after saving seed under bag and the selection of the best plants for two years. These plants have a large number of well developed, desirable leaves, with very few suckers or seed branches, as the result of careful seed selection.

PLATE II. Fig. 1.—Tobacco seed bed in Florida. This illustration shows plants just before transplanting. Note the uniformity of those grown from heavy seed. The bed, covering 2 acres, furnished enough plants for more than 100 acres of tobacco. Fig. 2.—Tobacco seed beds in Connecticut—tent, hotbed, and cold frame. The three best methods used for protecting tobacco seedlings in the North are shown. The beds in the center of the picture are covered with hotbed sash; the one on the right with cheese cloth raised about 12 inches above the surface of the bed; the one on the left is also covered with cheese cloth, arranged in the shape of a roof or tent and elevated sufficiently to allow workmen to walk about the bed without removing the cover. The glass covering seems to give the best results in most cases, and is conducive to the most rapid growth.

PLATE III. Fig. 1.—Transplanting tobacco seedlings with machine. The most satisfactory and practical transplanter is shown. By using this form of machine the seedlings may be set in the field whenever they are of the proper size, and easily watered. Fig. 2.—Sterilizing soil for tobacco seed beds. This method is cheap and effective, and serves to kill all weed seeds, fungi, and insects that may be in the soil.

PLATE IV. Fig. 1.—Tobacco seed separator. This form of separator is an improvement over the one originally devised in the Laboratory of Plant Breeding of the Bureau of Plant Industry, and described in the Yearbook of the Department of Agriculture for 1904. Fig. 2.—Seedlings from heavy, medium, and light tobacco seed. The seed from which the seedlings shown were grown was taken from the same lot and planted at exactly the same time. Note the increased growth and vigor in plants grown from heavy seed.

PLATE V. Fig. 1.—Method of "spearing" tobacco plants during harvest. This shows the most practical and economical means of spearing plants with the least possible injury to the leaves. The plants are allowed to wilt very slightly before spearing. Fig. 2.—Wagon rack for transporting plants to curing shed. The group of seed plants in the background shows lack of selection under the old practice.

PLATE VI. Fig. 1.—Capped plants saved for seed. The ordinary manila paper bag of the 12-pound size was used in capping these plants. The bag should be made of a thin grade of paper. Fig. 2.—Curing shed in the Connecticut Valley. The superior value of this form of curing shed is largely due to the large number of ventilators which may be opened to admit air when needed in properly curing tobacco.

PLATE VII. Fig. 1.—Seed plant ready for bag. In preparing the seed plant for bagging, as shown, the small leaves and suckers just below the seed head have been removed to make room for the bag. Fig. 2.—Proper arrangement of bag on seed plant. When the bag is placed on the flower head of the seed plant, as shown, it should be tied rather loosely around the stalk, to allow for its proper development.

PLATE VIII. Fig. 1.—Arrangement and structure of tobacco flowers. The structure of the flowers, as shown, gives evidence of the fact that tobacco flowers are naturally self-fertile. Fig. 2.—Two strains of Connecticut Broadleaf tobacco, the row on the left from an early parent and the row on the right from a late parent. The plant on the right of the center of the picture, from a late parent, is representative of the entire plat.

PLATE IX. Fig. 1.—Uniformity in time of maturity and other characters of two types of Connecticut Sumatra tobacco raised from seed saved under bag. This striking uniformity is due to three years of careful seed selection and protecting the flowers from cross-pollination. Each row represents a different strain of the tobacco. Fig. 2.—Lack of uniformity in time of maturity and other characters in ordinary Connecticut Broadleaf tobacco, where seed was not saved under bag.

FIG. 1.—TOBACCO SEED BED IN FLORIDA.

FIG. 2.—TOBACCO SEED BEDS IN CONNECTICUT—TENT, HOTBED, AND COLD FRAME.

FIG. 1.—TRANSPLANTING TOBACCO SEEDLINGS WITH MACHINE.

FIG. 2.—STERILIZING SOIL FOR TOBACCO SEED BEDS.

FIG. 1.—TOBACCO SEED SEPARATOR.

FIG. 2.—SEEDLINGS FROM HEAVY (32-3), MEDIUM (32-2), AND LIGHT (32-1) TOBACCO SEED.

FIG. 1.—METHOD OF "SPEARING" TOBACCO PLANTS DURING HARVEST.

FIG. 2.—WAGON RACK FOR TRANSPORTING PLANTS TO CURING SHED.

FIG. 1.—CAPPED PLANTS SAVED FOR SEED.

FIG. 2.—CURING SHED IN THE CONNECTICUT VALLEY.

FIG. 1.—SEED PLANT READY FOR BAG.

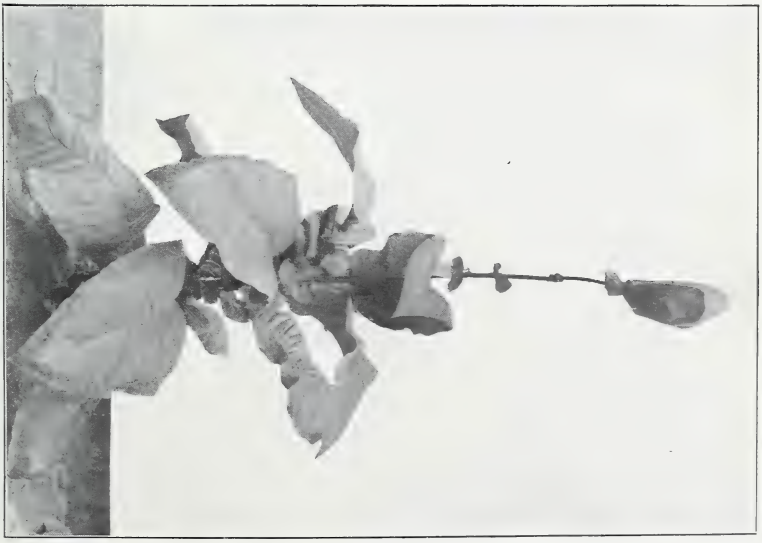

FIG. 2.—PROPER ARRANGEMENT OF BAG ON SEED PLANT.

FIG. 1.—ARRANGEMENT AND STRUCTURE OF TOBACCO FLOWERS.

FIG. 2.—TWO STRAINS OF CONNECTICUT BROADLEAF TOBACCO; THE ROW ON THE LEFT FROM AN EARLY PARENT, AND THE ROW ON THE RIGHT FROM A LATE PARENT.

FIG. 1.—UNIFORMITY IN TIME OF MATURITY AND OTHER CHARACTERS OF TWO TYPES OF CONNECTICUT SUMATRA TOBACCO RAISED FROM SEED SAVED UNDER BAG.

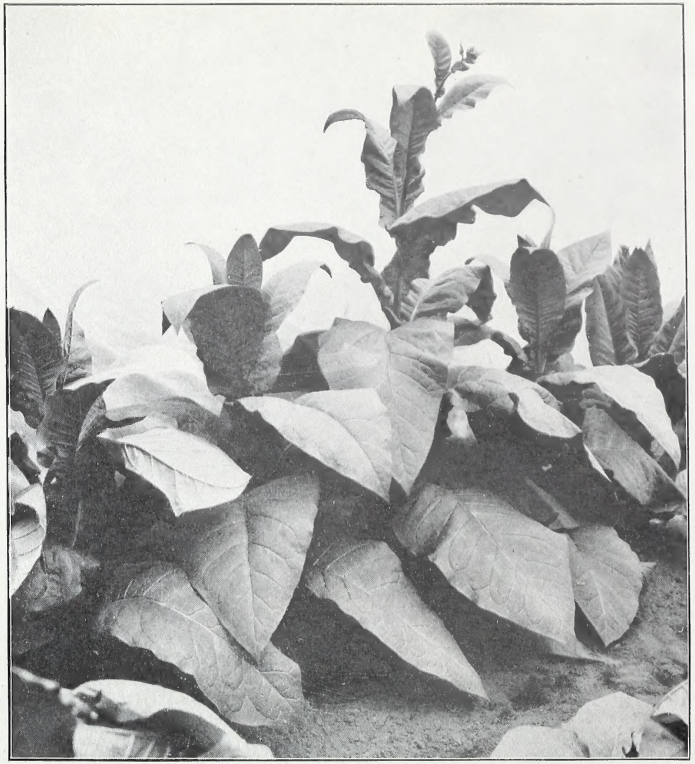

FIG. 2.—LACK OF UNIFORMITY IN TIME OF MATURITY AND OTHER CHARACTERS IN ORDINARY CONNECTICUT BROADLEAF TOBACCO.